3D animation model with augmented reality for natural science learning in elementary school

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3D animation model with augmented reality for natural science learning in elementary school

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Abstract. Many opinions from primary school students' on Natural Science are a difficult lesson. Many subjects are not easily understood by students, especially on materials that teach some theories about natural processes. Such as rain process, condensation and many other processes. The difficulty that students experience in understanding it is that students cannot imagine the things that have been taught in the material. Although there is material to practice some theories but is actually quite limited. There is also a video or simulation material in the form of 2D animated images. Understanding concepts in natural science lessons are also poorly understood by students. Natural Science learning media uses 3-dimensional animation models (3D) with augmented reality technology, which offers some visualization of science lessons. This application was created to visualize a process in Natural Science subject matter. The hope of making this application is to improve student's concept. This app is made to run on a personal computer that comes with a webcam with augmented reality. The app will display a 3D animation if the camera can recognize the marker.

1. Introduction

Nowadays the burden that given on elementary school student is very heavy. Students are charged with many subjects, yet most of them are really boring to them. Some uninteresting presentation on the textbooks we have seen does not help much. Traditional teaching methods with an expository approach should be needed to reduce. Teachers did not try to stimulate students to learn actively. This does not mean that the lecture method is bad, or the students did not understand the learning process. Variations in the learning process needed to encourage more students to actively learn. One of the lesson given the elementary school is Natural Science. The lesson is considered uninteresting to some students because the materials only consisting theories or images that do not make students understand the concept in a material

In reality, natural science seen difficult to understand so that children only passively learned and receive material as exact as written in textbooks. This raises the question on how to make students learn actively. This is a very decisive question on ways of teaching and learning science in elementary school that science learning is not only the determination to master the material, but what aspects of the Natural

Science needed to be taught and in a way that students can understand the concept well and able to apply logical concept in other situations relevant to their daily experience.

Based on the problems above we will made a display media to be able to make natural science become more interesting that can increase the understanding of the concept of elementary school students. Conceptual difficulties often occur in 1st, 2nd ,and 3rd grade. Therefore, the research material is limited only to first grade. Learning media that utilize augmented reality technology that can display visualization in the form of 3D animation. We hoped that augmented reality-based audiences can help elementary school students to understanding Natural Science.

1.1. Literature study

1.1.1. Natural Sciene. Natural Science Learning in elementary schools has three main objectives, there are developing scientific skills, understanding the concept of science and developing an attitude based on the values contained in its learning. Learning is an active process for students by constructing what they learn based on knowledge they know, rather than accepting things passively. Variations in the learning further process triggering students to actively learn [1]. Learn effectively by doing. However, the essence of activity in scientific learning is learning activity [2]. Natural Science lessons in 1st grade and 3rd grade of elementary school teach about the process and require further explanation so that students can understand the purpose of the material. Examples of 1st material are self-introduction and body parts [3].

1.1.2. Media. Media is a medium or communication tool. Media has a role that able affect the motivation, interest and attention of learners in learning and to visualize material taught to facilitate understanding. Besides being able to make learning more interesting, information given by visualizing the material will become clear and able to manipulate and present objects that are difficult to reach by learners [4].

1.1.3. 3D Object. 3-dimensional objects (3D) is an object / space that has a long, wide and high that has a shape. 3D concept shows an object or space has three geometric dimensions consisting of: depth, width and height. The term 3D is also used to denote representations in computer graphics (digital). Characteristics of 3D, referring to three spatial dimensions, that 3D shows a Cartesian X, Y and Z [5] cartesian coordinates.

1.1.4. Augmented Reality. Virtual reality is a technology that allows users to interact with an environment simulated by a computer. In virtual reality, information about the virtual world displayed to the user's senses can be displayed using a screen or head mounted display, audio using headphones, controllers, and even touch using special gloves. However, in its development virtual reality has a new branch that even rivalled the virtual reality itself. The technology is called Augmented Reality (AR). The principle of AR is interactive, immersion, realtime, and virtual objects are usually in 3-dimensional shape. In contrast to virtual reality that incorporates real objects (users) into virtual environments, augmented reality combines virtual objects in real environments. The main advantage of augmented reality versus virtual reality is its easier and cheaper development [6]. Another advantage that AR can be implemented widely in various media. In addition to adding virtual objects in a real environment, AR also hides the real environment from the user's view. AR can be applied to all senses, including hearing, touch, and smell. [7].

2. Methods

The research method can be seen in Figure 2, starting with identifying the problem so that it can be formulated to faced on the implementation of teaching and learning activities of natural science elementary school elementary level. Followed by a review of the literature related to the problems encountered faced. After obtained data, variables and research instruments will be designed to learn

applications used. The design stage begins with the creation of 3-dimensional model, making animation that will be displayed with augmented reality technology. Finally, an experiment on the system will be performed.

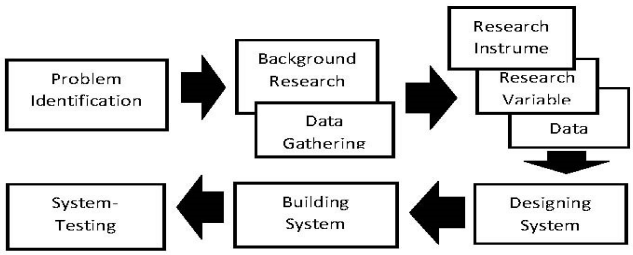


Figure 1. Research methods.

2.1. System Design

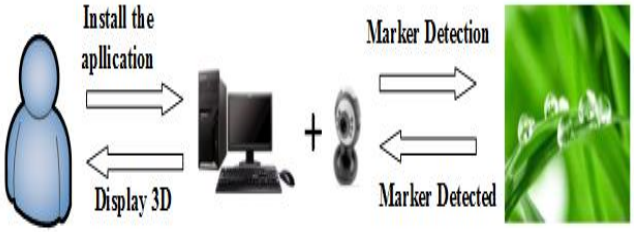
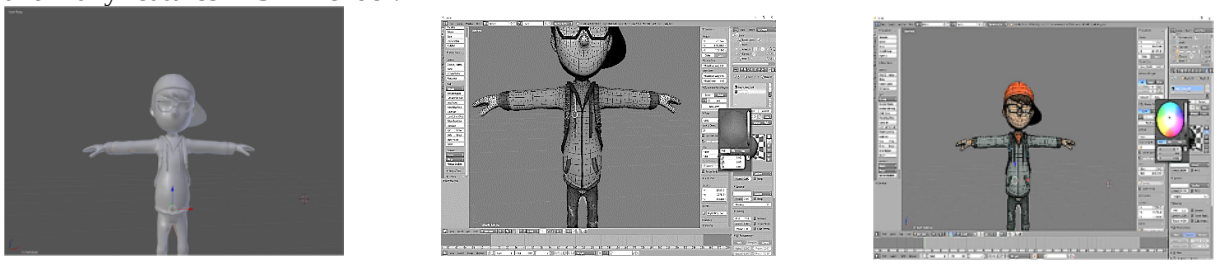


Figure 2. System design.

The research method can be seen in figure 2. Applications are made to be installed to a personal computer equipped with a webcam. Webcam will detect markers that have been previously identified. If the marker is recognized it will show a 3D animated image on a computer monitor screen related to natural science material. The material chosen for the 3D model is a class 1 material on the human body [3]. Applications are created using 3D Blender software, Unity 3D and Vuforia by Qualcomm [8].

2.2. Application Creation

2.2.1. 3D model animation with 3D Blender. To do 3D modeling, we use 3D Blender. Beginning with making the skeletons of the human body as shown on figure 3.(a). The process uses sphere components and many features in 3D Blender.



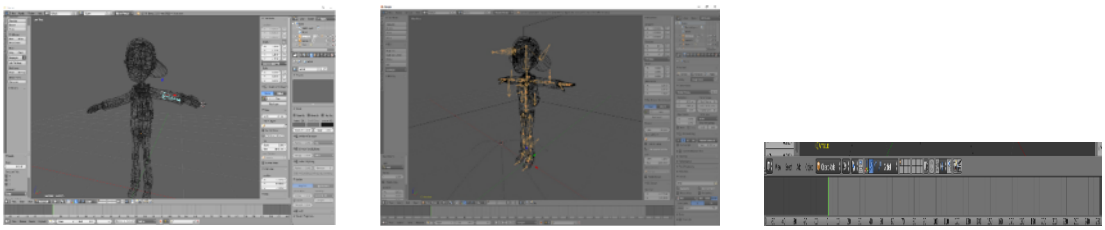
(a) (b) (c)

Figure 3. (a) Making the skeletons of the human body, (b) Texturing 3D Object, (c) 3D Object Coloring Technique with RGB Color.

Before texturing and coloring the 3D model, go to the Edit Mode menu first. For texturing, as seen in figure 3.(b), the display next to 3D Blender, can use the material to be used in accordance with 3D

objects of the human body model. As for coloring, choose 3D objects and use the RGB coloring technique like figure 3.(c).

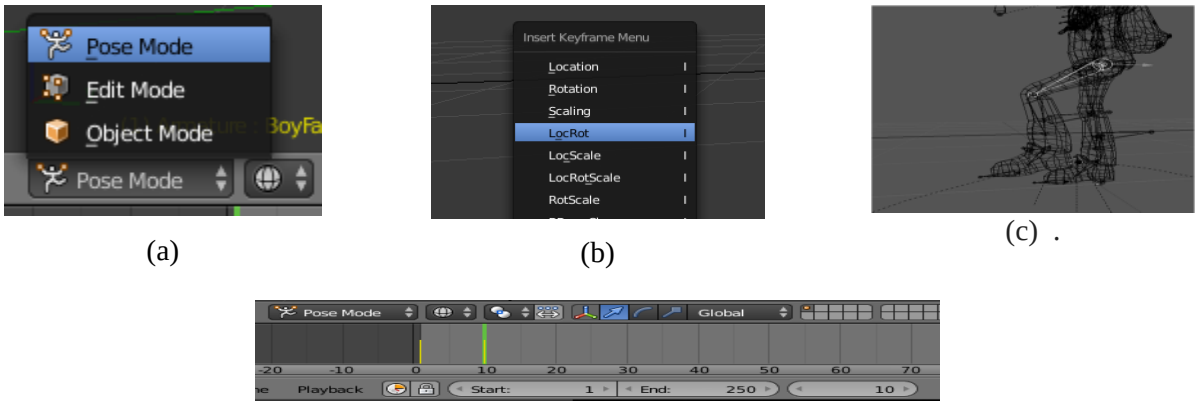
The third stage is to give a touch of animation to the 3D object model of the human body. In 3D Blender go into Pose Mode first to be able to use Armature to add bones (bones) inside 3D objects. Once added Armature, as shown in figure 4.(a). 3D objects are then added motion animation movement foot lift begins with rigging on Blender as in the figure 4.(b). Rigging is a technique of bone delivery where the object is given a bone arranged to resemble the original human body applied to the character object, so that the object can move just like how human actually move.



(a) (b) (c)

Figure 4. (a) Armature with 1 Bones, (b) The rigging applied to the Object, (c) Timeline used

In Blender, animation creation requires one feature called Timeline, where the animator can provide a frame reference for the animation that will run at 24 frames / sec or 24 pieces of the image alternately within a second. Here the animator uses about 10 frames as seen on figure 4. (c) that are used to provide animation in order to make changes from standing up to raising the knee. To move the bone itself to the object, the animator uses the pose mode as shown in figure 5. (a), which can only make the object move when it is incorporated with the bone (Armature) so that it becomes a rigging. No difference with video, on animation also needed called keyframe. A simple example is a change from one point to another, and to the next specified point. Here the animator uses LocRot as shown in Figure 5.(b) to make changes based on Location and Rotation.Thus, apart from those locations and locations, there will be no change of form on objects that are not given a keyframe. Followed by rigging on the femur and leg bones where LocRot performed by 10 frames as seen in figure 5. (c).

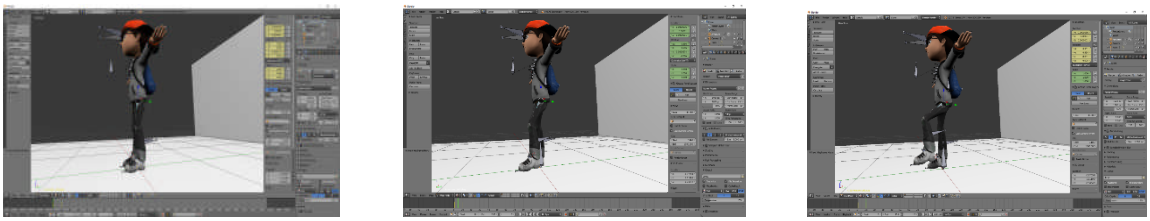


(a) (b) (c) .

(d)

Figure 5. (a) Pose Mode, (b) LocRot, (c) LocRot femur and leg bone, (d) Keyframe 0 to Frame 10.

The yellow line on the timeline indicates that the selected object that has experienced a keyframe. At that location or point it is explained that the keyframe runs from frame 0 to frame 10 as in figure 5.(c). Animation output lifts the foot of the object from frame 0, frame 5 and frame 10 can be seen on the figure 6.(a), (b) and (c).



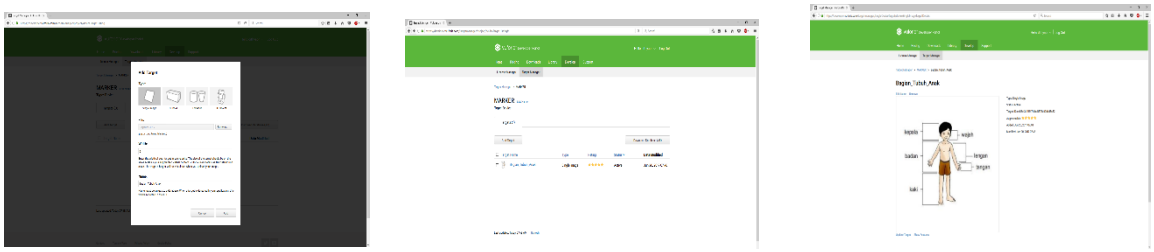
(a) (b) (c)

Figure 6. (a) Frame 0, (b) Frame 5, (c) Frame 10

After finishing the animation on the object, then the object in export into the form * .fbx file which in it already contains Objects and Animations that have been made through the Blender.

2.2.2. Using of Vuforia

The next step is to set up the marker used. To display a 3D object in front of the camera with Vuforia's help, first obtain the license key, by accessing the developer.vuforia.com website. Go to the License Manager tab and Add License Key. Next, go to the Target Manager tab to create a new Database. With the name MARKER and type Device. In Add Target select Single image type, file by pressing Browse button, and name can be written as you desire, this time with the name of Child Body Part, shown in figure 7.(a). If in figure 17 pressed Add button, it will look like figure 7.(b) indicating the marker image used. If selected or clicked on the Target Name "Bagian_Tubuh_Anak" it will display as shown in Figure 7.(c).

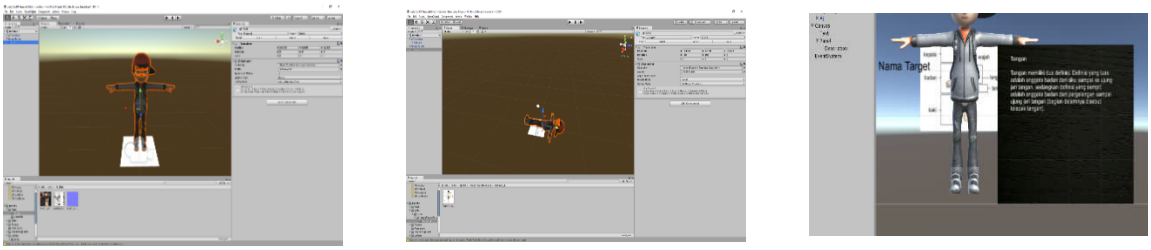


(a) (b) (c)

Figure 7. (a) Add Target, (b) Target Marker Result, (c) Marker results used for 3D AR.

2.2.3. Making marker with Unity

This software is used to be able to read the marker with the help of AR Camera inside Unity, so if marker is directed to camera then 3D object can be generated. The first step is to create a new project. Begin by importing Vuforia, markers and objects into Unity. On the left side there is Main Camera and Directional Light, then remove base camera on unity first, because in this project will use AR Camera. Followed by adding AR Camera and Image Target library Vuforia on Unity. Then insert a 3D object into Image Target indicating that if the marker is detected then that will exit the view of the 3D object, as in figure 8(a).



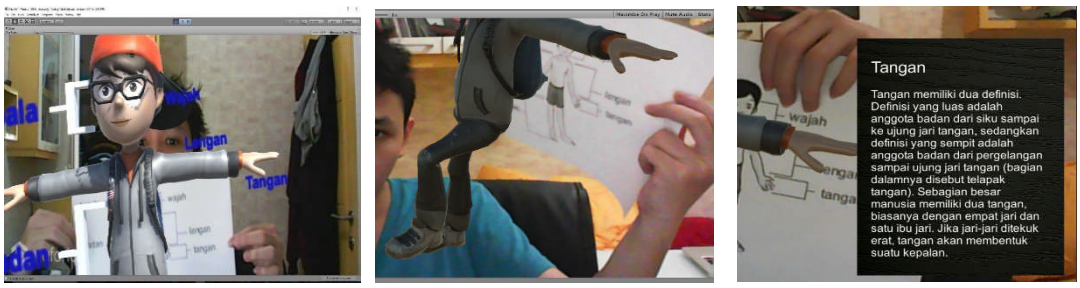
(a) (b) (c)

Figure 8. (a) 3D Object to Image Target, (b) Positioning the Target Image 3D Object, (c) Add Description.

AR Camera is set to enter the license key on Vuforia in Unity3D obtained from the Human_Marker_1 file which is the 3D object used, then copy the license key on the developer.vuforia.com website. Then, paste the App License Key and activate the dataset inside Unity3D. Target Image Enter the Database that has been created in Vuforia and its Target Image marker. Then position the 3D object and target image, so later the result can look well as in figure 8(b). And position also with Camera View which is in Unity3D software so that result of output later as desired. Next create a description of the 3D object with the help of Button information that displays a text description of the 3D AR object. Starting with adding a Canvas (Text) first, set the size that will appear in this text with the object, so the target is not wrong target. Add a panel inside the canvas. The addition of text on the panel, used to display the description button of the target 3D AR text object. If the text has been added, then the button inside the Panel is added. Followed by adding background and definitions. So when the camera later scanning, it will appear in accordance with the description of the section focused by the camera in Unity3D, looks like in figure 8(c).

3. Results and Discussion

Applications that have been created will be tested. If no marker is captured by the webcam then no 3D animated object appears. However, if the webcam can recognize markers that have been previously identified, will appear 3-dimensional animated object of a boy with the name of a body part, as shown in Figure 9(a). For output in the form of foot lift animation can be seen in Figure 9(b). Figure 9(c) is the output of hand use in the text.



(a) (b) (c)

Figure 9. (a) Output Results 3D AR objects, (b) 3D animated AR objects lift feet and (c) Use of hand objects in text

4. Conclusion

Making the application using 3D animation model on Blender 3D must be made with care, because if the model is made uninteresting, then it also ruined the purpose of this application which is intended for elementary school children. The marker-making step must follow the rules for 3D animated objects to appear if the camera captures a defined marker image. Type of marker used is single maker. The research

that is being made is still continuing for other materials in 1st, 2nd and 3rd grade. It is expected that the application can improve the understanding of elementary school children about concepts and processes as taught in science lessons

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